



**[6450-01-P]**

**DEPARTMENT OF ENERGY**

**10 CFR Part 430**

**[Docket No. EERE-2013-BT-TP-0008]**

**RIN: 1904-AC96**

**Energy Conservation Program for Consumer Products: Test Procedures for Residential Furnaces and Boilers**

**AGENCY:** Office of Energy Efficiency and Renewable Energy, Department of Energy.

**ACTION:** Final rule.

**SUMMARY:** On February 4, 2013, the U.S. Department of Energy (DOE) issued a notice of proposed rulemaking (NOPR) to amend its test procedure for residential furnaces and boilers, which serves as the basis for today's action. This final rule amends that test procedure by adopting new equations to facilitate calculation of the annual fuel utilization efficiency (AFUE) for certain classes of products when omitting specified heat-up and cool-down tests, as allowed under the test procedure if applicable criteria are met. The relevant industry test procedure, which is incorporated by reference in the current DOE test procedure, lacks equations necessary for the calculation of the heating seasonal efficiency (which contributes to the ultimate calculation of AFUE) of two-stage and modulating condensing furnaces or boilers when the option to omit the heat-up and cool-down tests is employed. This final rule revises the DOE test procedure to rectify this omission by adopting additional equations for the calculation of the part-

load efficiencies at the maximum input rate and reduced input rates for two-stage and modulating condensing furnaces and boilers when the manufacturer chooses to omit the heat-up and cool-down tests under the test procedure.

**DATES:** The effective date of this rule is **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**. The compliance date for use of the amended test procedure for purposes of compliance with energy conservation standards, as well as representations of energy efficiency or energy use, is **[INSERT DATE 180 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**. Voluntary early compliance is permitted.

**ADDRESSES:** The docket for this rulemaking is available for review at [www.regulations.gov](http://www.regulations.gov), including Federal Register notices, public meeting attendee lists and transcripts, comments, and other supporting documents/materials. All documents in the docket are listed in the [www.regulations.gov](http://www.regulations.gov) index. However, not all documents listed in the index may be publicly available, such as information that is exempt from public disclosure.

A link to the docket web page can be found at:  
<http://www.regulations.gov/#!docketDetail;D=EERE-2013-BT-TP-0008>. This web page contains a link to the docket for this final rule on the [www.regulations.gov](http://www.regulations.gov) site. The [www.regulations.gov](http://www.regulations.gov) web page contains simple instructions on how to access all documents, including public comments, in the docket.

For further information on how to review the docket, contact Ms. Brenda Edwards at (202) 586-2945 or by email: [Brenda.Edwards@ee.doe.gov](mailto:Brenda.Edwards@ee.doe.gov).

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## **I. Authority and Background**

Title III, Part B<sup>1</sup> of the Energy Policy and Conservation Act of 1975 (“EPCA” or “the Act”), Pub. L. 94-163 (42 U.S.C. 6291-6309, as codified) set forth a variety of provisions designed to improve energy efficiency and established the Energy Conservation Program for Consumer Products Other Than Automobiles.<sup>2</sup> These include residential furnaces and boilers, the subject of today’s rulemaking. (42 U.S.C. 6292(a)(5))<sup>3</sup>

Under EPCA, the energy conservation program consists essentially of four parts: (1) testing; (2) labeling; (3) Federal energy conservation standards; and (4) certification and enforcement procedures. The testing requirements consist of test procedures that manufacturers of covered products must use as the basis for: (1) certifying to DOE that their products comply with the applicable energy conservation standards adopted pursuant to EPCA, and (2) making representations about the efficiency of those products. (42 U.S.C. 6293(c); 42 U.S.C. 6295(s)) Similarly, DOE must use these test procedures to determine whether the products comply with any relevant standards promulgated under EPCA. (42 U.S.C. 6295(s))

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<sup>1</sup> For editorial reasons, upon codification in the U.S. Code, Part B was redesignated Part A.

<sup>2</sup> All references to EPCA in this document refer to the statute as amended through the American Energy Manufacturing Technical Corrections Act (AEMTCA), Pub. L. 112-210 (Dec. 18, 2012).

<sup>3</sup> Under 42 U.S.C. 6292(a)(5), the statute establishes “furnaces” as covered products. Originally, boilers were considered a class of furnaces. However, amendments to EPCA in the Energy Independence and Security Act of 2007 (EISA 2007), Pub. L. 110-140 (Dec. 19, 2007), distinguished between furnaces and boilers in 42 U.S.C. 6295(f) by adding the text “and boilers” to the title of that section and by prescribing standards for boiler products. Although EISA 2007 did not similarly update 42 U.S.C. 6292(a)(5), it is implicit that this coverage continues to include boilers.

Under 42 U.S.C. 6293, EPCA sets forth the criteria and procedures DOE must follow when prescribing or amending test procedures for covered products. EPCA provides, in relevant part, that any test procedures prescribed or amended under this section must be reasonably designed to produce test results which measure energy efficiency, energy use, or estimated annual operating cost of a covered product during a representative average use cycle or period of use, and must not be unduly burdensome to conduct. (42 U.S.C. 6293(b)(3)) In addition, if DOE determines that a test procedure amendment is warranted, it must publish proposed test procedures and offer the public an opportunity to present oral and written comments on them. (42 U.S.C. 6293(b)(2))

DOE's current energy conservation standards for residential furnaces and boilers are expressed as minimum AFUE. AFUE is an annualized fuel efficiency metric that fully accounts for fuel consumption in active, standby, and off modes. The existing DOE test procedure for determining the AFUE of residential furnaces and boilers is located at 10 CFR part 430, subpart B, Appendix N, Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers. The current DOE test procedure for residential furnaces and boilers was originally established by a final rule published in the Federal Register on May 12, 1997, and it incorporates by reference the American National Standards Institute (ANSI)/American Society of Heating, Refrigerating, and Air-conditioning Engineers (ASHRAE) Standard 103-1993, Method of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers (ASHRAE 103-1993). 62 FR 26140, 26157 (incorporated by reference at 10 CFR 430.3(f)(9)). On October 14, 1997, DOE published an interim final rule in the Federal Register to revise a provision concerning the insulation of the flue collector box in order to ensure the updated test

procedure would not affect the measured AFUE of existing furnaces and boilers. 62 FR 53508. This interim final rule was subsequently adopted without change in a final rule published in the Federal Register on February 24, 1998. 63 FR 9390.

On October 20, 2010, DOE amended its test procedure for furnaces and boilers to establish a method for measuring the electrical energy use in standby mode and off mode for gas and oil-fired furnaces and boilers pursuant to requirements established by EISA 2007. 75 FR 64621. These test procedure amendments were primarily based on and incorporated by reference provisions of the International Electrotechnical Commission (IEC) Standard 62301 (First Edition), Household electrical appliances—Measurement of standby power. On December 31, 2012, DOE published a final rule in the Federal Register that updated the incorporation by reference of the standby mode and off mode test procedure provisions to refer to the latest edition of IEC Standard 62301 (Second Edition). 77 FR 76831.

On January 4, 2013, DOE published a request for information (RFI) in the Federal Register seeking comment and information on a variety of issues relating to the residential furnace and boiler AFUE test method. 78 FR 675. Key issues discussed in the RFI include avenues for reducing test burden and the addition of a performance test for automatic means of adjusting water temperature in hot water boilers. The RFI began the process of fulfilling DOE's obligation to periodically review its test procedures under 42 U.S.C. 6293(b)(1)(A) by initiating a rulemaking to examine all aspects of the DOE test procedure. The RFI is broader in scope than today's final rule, which is limited to adding omitted equations to the residential furnace and boiler test procedure.

On February 4, 2013, DOE published a NOPR in the Federal Register (hereinafter the “February 2013 NOPR”) regarding the test procedure for residential furnaces and boilers. The February 2013 NOPR was focused on an issue with the test procedure where equations were missing that would be needed to calculate the efficiency of two-stage and modulating condensing furnaces and boilers tested using an option to omit the heat-up and cool-down portions of the test. 78 FR 7681. The NOPR proposed the adoption of two new test procedure equations that would remedy the issue and allow for the calculation of the efficiency of two-stage and modulating condensing furnaces and boilers that were tested using the option to omit the heat-up and cool-down tests. On March 13, 2013 DOE held a public meeting to discuss the test procedure proposals outlined in the February 2013 NOPR. Today’s final rule is the culmination of the rulemaking process that began with the February 2013 NOPR.

## **II. Summary of the Final Rule**

Today’s final rule amends DOE’s test procedure for residential furnaces and boilers by incorporating additional equations to account for the use of section 9.10 (Optional Test Procedure for Condensing Furnaces and Boilers That Have No Off-Period Flue Losses) of ASHRAE 103-1993, which is incorporated by reference into the DOE test procedure for two-stage and modulating condensing furnaces and boilers at Appendix N to subpart B of 10 CFR part 430. Section 9.10 of ASHRAE 103-1993 allows certain condensing furnaces and boilers to omit the heat-up and cool-down tests provided that the model: (1) has no measurable airflow through the combustion chamber and heat exchanger during the burner off-period; and (2) has post-purge periods of less than 5 seconds.

Prior to issuance of this final rule, DOE's test procedure for residential furnaces and boilers lacked the equations necessary to calculate the heating seasonal efficiency (which contributes to the ultimate calculation of AFUE) if the option in section 9.10 is selected and the heat-up and cool-down tests are omitted when testing two-stage and modulating condensing furnaces and boilers. Omission of these equations causes erroneous results for AFUE when calculated using the DOE test method. (This situation is in contrast to that of single-stage condensing furnaces and boilers, where the requisite equations were already present in the DOE test procedure.)

To correct this issue, DOE proposed to adopt two new equations in the February 2013 NOPR. These new equations would allow for the calculation of the part-load efficiencies at the maximum input rate and reduced input rates (and ultimately AFUE) of two-stage and modulating condensing furnaces and boilers when omitting the heat-up and cool-down tests, as provided under section 9.10 of ASHRAE 103-1993. Today's final rule adopts the equations proposed in the February 2013 NOPR, as described in more detail in section III.

DOE has concluded that any test procedure changes resulting from this rulemaking should not impact the existing energy conservation standards for residential furnaces and boilers, because such changes simply allow for the generation of accurate information reflecting the efficiency of affected basic models, which typically test above the existing minimum standard level. The current minimum energy conservation standards are based on AFUE ratings that correspond to non-condensing furnaces and boilers, and those values will not change as a result



of today's final rule to remedy the omission of necessary equations pertaining to condensing models. DOE does not foresee that a model that would need to be re-rated using the equations adopted in today's final rule would have a resulting AFUE below the minimum required efficiency.

### **III. Discussion**

#### **A. Statement of the Issue and the NOPR's Proposed Corrective Action**

As discussed briefly above, this final rule addresses an omission in the current DOE test procedure by adopting a new set of equations to accurately calculate the AFUE for two-stage and modulating condensing furnaces and boilers when tested pursuant to the optional procedure to skip the heat-up and cool-down tests, as described in section 9.10 of ASHRAE 103-1993. Section 9.10 of ASHRAE 103-1993, which is incorporated by reference into the DOE test procedure for use at Appendix N to subpart B of 10 CFR part 430 allows omission of the heat-up and cool-down tests for certain condensing furnaces and boilers provided the model (1) has no measurable airflow through the heat exchanger during the burner off period; and (2) has post purge period(s) of less than 5 seconds.

For single-stage condensing furnaces and boilers, section 11.3.11.3 of ASHRAE 103-1993 provides equations necessary to accurately calculate the heating seasonal efficiency (which contributes to the ultimate calculation of AFUE). One equation is based on the results of the heat-up and cool-down tests described in sections 9.5 and 9.6 of ASHRAE 103-1993 and is to be used if these tests were conducted, and the other equation is based on the results of the steady-

state test described in section 9.1 of ASHRAE 103-1993 and is to be used if heat-up and cool-down tests were not conducted and the option in section 9.10 was employed instead.

For two-stage and modulating condensing furnaces and boilers there are no equations provided in ASHRAE 103-1993 to calculate the heating seasonal efficiency if the option in section 9.10 is selected. The only equation provided in the test procedure to calculate the heating seasonal efficiency for two-stage and modulating condensing furnaces and boilers requires values for the part-load efficiencies, which are based on the results of the heat-up and cool-down tests. If two-stage and modulating condensing furnaces or boilers were tested and the heat-up and cool-down tests were omitted in accordance with section 9.10, the part-load efficiencies, heating seasonal efficiency, and resulting AFUE would not be able to be calculated using the equations provided in the DOE test method.

DOE is aware that many boiler manufacturers have utilized the optional section 9.10 provisions for two-stage and modulating condensing boilers, regardless of the fact that no equations exist in section 11.5.11 that would provide for the calculation of the part-load efficiencies for such equipment. In calculating the AFUE, DOE believes manufacturers that opted to omit the heat-up and cool-down portions of the test have erroneously used “0” for the temperatures that would be taken during the heat-up and cool-down tests. Research into this issue conducted by the furnace and boiler industry trade association (i.e., the Air-conditioning, Heating, and Refrigeration Institute (AHRI)) revealed that AFUE values calculated for boilers using this approach could be inflated from one to four percent above their true values. (AHRI, No. 1 at p. 6)

In the February 2013 NOPR, DOE proposed to amend the test procedure to include equations for calculating part-load efficiencies at the maximum input rate and at reduced input rates and, ultimately, the AFUE of two-stage and modulating condensing furnaces and boilers when utilizing the option to omit the heat-up and cool-down tests, as provided under section 9.10 of ASHRAE 103-1993. DOE developed these equations in the February 2013 NOPR by following the concept of replacing cyclic infiltration and sensible heat losses with steady-state infiltration and sensible heat losses. This concept is already used in ASHRAE 103-1993 for single-stage units and can be applied to two-stage and modulating units as well. DOE proposed to add the following equations to Appendix N in the February 2013 NOPR for calculating the part-load efficiency at reduced and maximum fuel input rates for two-stage and modulating units that are tested according to section 9.10 of ASHRAE 103-1993:

#### Part-Load Efficiency at Reduced Fuel Input Rate

$$Eff_{V,R} = 100 - L_{L,A} + L_G - L_C - C_I L_I - \left[ \frac{t_{ON}}{t_{ON} + \left( \frac{Q_P}{Q_{IN}} \right) t_{OFF}} \right] (C_S)(L_{S,SS})$$

where:

$L_{S,SS}$  = value as defined in section 11.5.6 at reduced input rate  
 $C_S$  = value as defined in section 11.5.10.1 at reduced input rate

#### Part-Load Efficiency at Maximum Fuel Input Rate

$$Eff_{V,H} = 100 - L_{L,A} + L_G - L_C - C_I L_I - \left[ \frac{t_{ON}}{t_{ON} + \left( \frac{Q_P}{Q_{IN}} \right) t_{OFF}} \right] (C_S)(L_{S,SS})$$

where:

$L_{S,SS}$  = value as defined in section 11.5.6 at maximum input rate  
 $C_S$  = value as defined in section 11.5.10.1 at maximum input rate

78 FR 7681, 7694-95 (Feb. 4, 2013).

DOE conducted testing on two modulating condensing residential boilers to validate the equations shown above. The test results verified that AFUE values determined by omitting the heat-up and cool-down tests and using the new equations were consistent with the AFUE values determined using the heat-up and cool-down tests. As the results presented in the February 2013 NOPR demonstrate, there was no more than a 0.04 percent variance in AFUE determined under the new equations, as compared to the AFUE determined using the results of the heat-up and cool-down tests. 78 FR 7681, 7686-89 (Feb. 4, 2013). In DOE's view, the difference between the two calculation methods is small enough that the AFUE values using the new equations are representative of the actual performance of the models. Thus, the resulting values are an accurate representation of the product's energy efficiency for consumer information purposes. Further, the adoption of the new equations would result in minimal additional test burden for manufacturers that need to recalculate efficiency ratings, or would reduce test burden for manufacturers in comparison to performing heat-up and cool-down tests.

#### B. Discussion of Comments

In addition to input at the March 2013 public meeting, DOE received five written comment submissions in response to the February 2013 NOPR, including comments from Lochinvar, AHRI, Heat Transfer Products (HTP), the American Public Gas Association

(APGA), and the National Propane Gas Association (NPGA). These comments, along with DOE's response, are summarized immediately below.

In general, Lochinvar, AHRI, and HTP were supportive of the proposed amendments to the residential furnace and boiler test procedure as outlined in the February 2013 NOPR. (Lochinvar, No. 6 at p. 1; AHRI, No. 9 at p. 1; HTP, No. 10 at p. 1) However, AHRI recommended that DOE further simplify the equations by setting the input rate of the pilot light to zero, noting that continuous pilot lights are no longer allowed on gas boilers, and, therefore, there is no reason to account for them in the new equation. (AHRI, Public Meeting Transcript, p.21) In addition, Lochinvar stated that 10 CFR part 430, subpart B, Appendix N contains internal references in need of appropriate renumbering. (Lochinvar, No.8 at p. 2)

DOE agrees that Appendix N contains internal references in need of renumbering--a matter which DOE has addressed in today's final rule.

DOE considered AHRI's point regarding further simplification of the equations, but declines to set the input rate of the pilot light to zero. DOE notes that the equations proposed for addition to the test procedure would be utilized not just for boilers, but also potentially for furnaces, if furnace manufacturers wish to avail themselves of the option provided in section 9.10 of ASHRAE 103-1993. Although a standing pilot is uncommon on furnaces on the market today, this feature is not specifically prohibited for furnaces, leaving open the possibility that a furnace may have a standing pilot light. Additionally, DOE believes that the burden of setting the pilot energy to zero in the equation is insignificant and does not warrant the removal of this

term altogether, and that doing so could cause confusion and render the equations useless for a product equipped with a standing pilot.

HTP stated that the tracer gas test in Appendix D of ASHRAE 103-1993 used to determine the off-cycle airflow is cumbersome and difficult to understand. HTP recommended that the Department consider the presence of any type of damper mechanism in the combustion product path (upstream or downstream) to serve as proof that there is no off-cycle losses associated with the flow rates of gases. (HTP, No. 10 at p.2)

DOE believes HTP's comment regarding the tracer gas test may have merit, but notes that this comment is outside the scope of this particular rulemaking, which is meant to remedy an omission in the residential furnace and boiler test procedure impacting manufacturers' ability to calculate AFUE of certain models. Instead, DOE will consider the issue of the tracer gas test in its proceedings for its broader test procedure rulemaking initiated by the January 2013 RFI.

Two manufacturers requested clarification as to how the changes proposed in the NOPR would affect the certification of residential furnaces and boilers. (Lochinvar, No. 6 at p. 1; HTP, No. 10 at p. 1) Lochinvar requested clarification as to whether the new calculations were meant to be an additional option or a replacement to conducting the heat-up and cool down-tests. (Lochinvar, Public Meeting Transcript, No. 5 at p. 17) HTP asked if manufacturers would be expected to use the same method of calculation for all models in a product line. (HTP, Public Meeting Transcript, No. 5 at pp.18-19)

Today's final rule modifies the residential furnace and boiler test procedure to provide a means to accurately calculate AFUE for two-stage and modulating condensing furnace and boiler models meeting the criteria outlined in section 9.10, which permit omission of the otherwise-required heat-up and cool-down tests. As amended, the DOE test procedure provides two methods of calculation for models complying with the criteria outlined in section 9.10. Manufacturers have discretion to choose to rate such models either by using the procedures under section 9.10, or by using the data obtained in the cool-down and heat-up tests under sections 9.5 and 9.6, respectively. Manufacturers may choose either or both options for models within a single product line.

If manufacturers have previously utilized the option provided in section 9.10 for testing and rating the efficiency of two-stage and modulating condensing furnaces or boilers, manufacturers must either retest for efficiency without using section 9.10, or recalculate the efficiency using the new equations being adopted in today's final rule. If retesting a given basic model using the methodology being adopted in this final rule results in a certified rating that is more consumptive or less efficient than its currently certified value, then the manufacturer must also recertify the basic model with the revised rating to the Department by the compliance date of the test procedure amendments being adopted in this final rule.

The APGA and the NPGA encouraged DOE to include a metric that accounts for the full-fuel cycle as part of the residential furnace and boiler test procedure. (APGA, No.7 at p. 1; NPGA, No. 8 at p.1) Once again, DOE notes that today's final rule is limited in scope to remedying the above-discussed error in the DOE test procedure. However, DOE will consider

this issue in the context of the broader test procedure rulemaking initiated by the January 2013 RFI.

### C. Final Corrective Action

After considering comments presented at the March 13, 2013 public meeting, and additional written comments submitted following the public hearing, the Department is adopting the amendments proposed in the February 2013 NOPR (discussed in section III.A) with minor clarifications to the section numbering, as suggested by interested parties in comments on the NOPR. The amendments in today's final rule include a revised method for calculating the AFUE for two-stage and modulating condensing furnaces and boilers. While this change may lead to a revised AFUE rating for certain residential furnaces or boilers, as discussed above, DOE does not believe that the resulting changes in AFUE would require amending the applicable energy conservation standard or affect compliance with the standard by the models at issue here. As noted, the previously omitted equations apply only to two-stage and modulating condensing models, which are highly efficient and, even using the amended equations, are expected to achieve ratings well above the minimum standards. The current minimum energy conservation standards are based on AFUE ratings that correspond to non-condensing furnaces and boilers, and those values would not change as a result of today's amendments to remedy the omission of necessary equations pertaining to condensing models. DOE does not foresee that a model that would need to be re-rated using the equation adopted in today's notice would have a resulting AFUE below the minimum required efficiency.



#### D. Effective and Compliance Dates

The final rule amendments discussed in this rulemaking are effective on **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**.

Consistent with 42 U.S.C. 6293(c), commencing on **[INSERT DATE 180 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**, manufacturers must make representations of energy efficiency and energy consumption of residential furnaces and boilers using this amended test procedure. Until that time, manufacturers may make such representations based either on the final amended test procedure or on the previous test procedure, set forth at 10 CFR part 430, subpart B, appendix N as contained in the 10 CFR parts 200 to 499 edition revised as of January 1, 2013. Consistent with 42 U.S.C. 6291(8), representation of energy consumption means measures of energy use (including for this product, active mode, standby mode, and off mode energy use), annual operating cost, energy efficiency (including for this product, AFUE), or other measure of energy consumption. Given that the amended test procedure provides necessary equations which permit the omission of otherwise applicable heat-up and cool-down tests, manufacturers may wish to avail themselves of the opportunity for early compliance.

Manufacturers must make any certifications of compliance with the existing AFUE-based energy conservation standards using this amended test procedure on **[INSERT DATE 180 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**. Until that time, manufacturers may make certifications of compliance based either on the final amended test procedure or on the previous test procedure, set forth at 10 CFR part 430, subpart B, appendix N as contained in the 10 CFR parts 200 to 499 edition revised as of January 1, 2013.

Again, given that the amended test procedure provides necessary equations which permit the omission of otherwise applicable heat-up and cool-down tests, manufacturers may wish to avail themselves of the opportunity for early compliance.

#### **IV. Procedural Issues and Regulatory Review**

##### **A. Review Under Executive Order 12866**

The Office of Management and Budget (OMB) has determined that test procedure rulemakings do not constitute “significant regulatory actions” under section 3(f) of Executive Order 12866, “Regulatory Planning and Review,” 58 FR 51735 (Oct. 4, 1993). Accordingly, this regulatory action was not subject to review under the Executive Order by the Office of Information and Regulatory Affairs (OIRA) in OMB.

##### **B. Review under the Regulatory Flexibility Act**

The Regulatory Flexibility Act (5 U.S.C. 601 et seq., as amended) requires preparation of an initial regulatory flexibility analysis (IRFA) for any rule that by law must be proposed for public comment and a final regulatory flexibility analysis (FRFA) for any such rule that an agency adopts as a final rule, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. A regulatory flexibility analysis examines the impact of the rule on small entities and considers alternative ways of reducing negative effects. Also, as required by Executive Order 13272, “Proper Consideration of Small Entities in Agency Rulemaking,” 67 FR 53461 (August 16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the DOE rulemaking process. 68 FR

7990. DOE has made its procedures and policies available on the Office of the General Counsel's website: <http://energy.gov/gc/office-general-counsel>.

DOE reviewed today's final rule under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003. DOE has concluded that the rule would not have a significant impact on a substantial number of small entities. The factual basis for this certification is as follows:

For manufacturers of residential furnaces and boilers, the Small Business Administration (SBA) has set a size threshold, which defines those entities classified as "small businesses" for the purposes of the Act. DOE used the SBA's small business size standards to determine whether any small entities would be subject to the requirements of the rule. 13 CFR part 121. These size standards and codes are established by the North American Industry Classification System (NAICS) and are available at [http://www.sba.gov/sites/default/files/files/Size\\_Standards\\_Table.pdf](http://www.sba.gov/sites/default/files/files/Size_Standards_Table.pdf). Residential boiler manufacturing is classified under NAICS 333414, "Heating equipment (except warm air furnaces) manufacturing," for which the size threshold is 500 employees. Residential furnace manufacturing is classified under NAICS 333415, "Air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufacturing" for which the size threshold is 750 employees. DOE surveyed the AHRI certification directories for furnaces and boilers, as well as the SBA database and market research tools (e.g., Hoovers<sup>4</sup>), to identify manufacturers of residential furnaces and boilers. DOE then consulted publicly available data or contacted companies, as necessary, to determine if they meet the SBA's definition of a "small

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<sup>4</sup> For more information see: <http://www.hoovers.com/>.

business” manufacturer, and have their manufacturing facilities located within the United States. Based on this analysis, DOE identified 11 small businesses that manufacture residential furnaces, and 14 small businesses that manufacture residential boilers (two of which also manufacture residential furnaces), for a total of 23 small businesses potentially impacted by this rulemaking.

DOE believes the equations being adopted today would lessen manufacturer burden in comparison to application of the current test procedure. Today’s final rule amends DOE’s test procedure by incorporating additional equations to account for the use of section 9.10 of ASHRAE 103-1993 (the relevant industry standard incorporated by reference) for two-stage and modulating condensing furnaces and boilers. Section 9.10 permits a manufacturer of condensing furnaces and boilers the option to omit the specified heat-up and cool-down tests if the model has no measurable airflow through the combustion chamber and heat exchanger during the burner off period and has post-purge period(s) of less than 5 seconds. However, under the DOE test procedure, the equations needed to use section 9.10 did not exist for two-stage and modulating condensing models. As a result, the only available method to properly rate the performance of two-stage and modulating condensing furnaces and boilers has been conducting the heat-up and cool-down tests. Because section 9.10 previously lacked the requisite equations, manufacturers who used that option to rate the AFUE of their two-stage and modulating condensing furnace and boiler models will need to re-rate their models using either today’s new equations or the results of heat-up and cool-down tests.

The estimated costs of re-rating using the new equations (for manufacturers who had incorrectly applied the test procedure) is discussed below, along with the estimated costs of conducting the heat-up and cool-down tests.

In the February 2013 NOPR, DOE stated that manufacturers are likely to choose one of two approaches to use the new equations to recalculate the efficiency of two-stage and modulating condensing models for which section 9.10 has been employed: (1) manufacturers might recalculate the efficiency for each model individually by doing the calculations manually; or (2) manufacturers might update the AFUE calculation computer program to account for the new equations. 78 FR 7681, 7690 (Feb. 4, 2013).

In the NOPR, DOE estimated that recalculating the AFUE manually using the new equation would take between 30 minutes and 1 hour per basic model. At an hourly rate of \$60 for a test lab technician, DOE estimated that each model that is re-rated in this manner would cost approximately \$30 to \$60. Id.

Alternatively, an individual manufacturer may decide to reprogram its software for calculating AFUE to account for the new equation. In the NOPR, DOE estimated that a programmer would need between 16 and 40 hours to rewrite the program code to account for this new equation. At an hourly rate of \$80 for a programmer, the resulting cost would be a one-time expenditure of \$1280 to \$3200 to update the automatic AFUE calculation program. Id. HTP stated a concern that if each manufacturer is required to modify the AFUE calculation software to account for these corrections, unintended variation may be introduced to the market place.

HTP commented that they expect the modification of the software to cost approximately \$5,000 for each manufacturer. (HTP, No. 10 at p. 2)

DOE believes that the equations being adopted in today's NOPR are clear and unambiguous enough that they could be implemented in the program in a consistent manner and does not agree that unintended variation from manufacturer to manufacturer would be a major concern. Further, in the NOPR, DOE noted that given the role AHRI has traditionally played and the potential for cost savings for AHRI members, AHRI may decide to reprogram its software. In this case, the software would be uniform for AHRI members, and the effort required to recalculate AFUE for individual manufacturers, would be much less than the cost AHRI would incur to modify the program. 78 FR 7681, 7690 (Feb. 4, 2013). Regarding HTP's assessment of the cost to reprogram the relevant software, DOE believes that \$5,000 is not unreasonable as a rough estimate. However, DOE's estimate in the NOPR was more refined, being based on actual quotes obtained from computer programmers familiar with the AFUE calculation program that is currently used by industry. DOE's estimates of the programming time needed to add the two equations were conservatively based on actual information received from programmers. HTP did not provide any data in the form of the hourly cost of a programmer or the time required that would lead DOE to change its estimates. Thus, DOE believes that the total cost to reprogram the current industry software would fall in the range of \$1280 to \$3200, which is based on a cost of \$80 per hour for a programmer and 16 to 40 hours of programming time. Further, DOE notes that even at \$5,000, the cost would be small compared to the overall cost of manufacturing, testing, and certifying residential furnace and boiler products, making the impact of this option minimal for manufacturers. As noted in the February

2013 NOPR, if these costs were spread over the cost of each model re-certified, the cost on a per-model basis would be much lower.

At the time of this publication, the AHRI certification directories for residential furnaces and boilers contain a combined total of approximately 2000 active condensing models for which recalculation could potentially be required, although only a fraction of the total condensing models would be two-stage and modulating products which might need to be re-rated using the new equations. Further, AHRI required member manufacturers of condensing two-stage or condensing modulating boilers to either: (1) re-rate their products at 90 percent AFUE; (2) discontinue the model; or (3) substantiate the model's efficiency rating by providing data from the heat-up and cool-down tests. (AHRI, No. 1 at p. 2) DOE examined the number of models in the AHRI certified directory for boilers that are rated at 90-percent AFUE (the majority of which are likely to be re-rated models that used option 9.10) and found that there are 210 models rated at 90-percent AFUE. If all of these models were to be re-rated through the use of the updated computer program, the per-model cost would be \$6 to \$15.

In the February 2013 NOPR, DOE estimated that conducting the heat-up and cool-down tests would require 2 hours combined for two-stage and modulating condensing products. 78 FR 7681, 7690 (Feb. 4, 2013). DOE estimated that at \$60 per hour for a lab technician, the cost to perform the heat-up and cool-down tests is approximately \$120 per model.

During the public meeting, Lochinvar commented that the February 2013 NOPR only accounted for the cost to perform the heat-up and cool-down tests. However, according to

Lochinvar, manufacturers do not have the option of conducting the heat-up and cool-down test on one unit of a particular model and incorporating that data along with the steady-state test data from another unit of the same model to obtain an AFUE rating. As a result, Lochinvar contended that if a manufacturer had incorrectly rated their equipment under the existing test procedure and wished to re-rate the equipment using the heat-up and cool-down tests rather than using the section 9.10 method, the entire test would need to be performed again on that product or that family of products. Lochinvar stated that this would mean that the test burden would be at least 10 times the cost DOE listed in the February 2013 NOPR. (Lochinvar, Public Meeting Transcript, No. 5 at p. 24) HTP stated that impact for small businesses would be a significantly higher proportional cost relative to their revenue than it would be for large manufacturers. HTP estimated that the cost of addressing this issue, including re-rating and expenditure of company time, has cost HTP between \$250,000 and \$300,000. (HTP, No. 10 at p. 2)

DOE agrees that manufacturers seeking to re-rate their units by conducting the heat-up and cool-down tests may also need to conduct the steady-state portion of the test to obtain an accurate efficiency rating. DOE estimates that the cost of conducting the entire test method at a test lab would cost manufacturers approximately \$1600 per unit.

The costs to manufacturers of utilizing the equations being adopted in today's final rule is significantly lower than the cost of re-rating the models by performing the heat-up and cool-down tests, regardless of whether manufacturers choose to recalculate the efficiencies by hand or to update the automatic AFUE calculation program. Thus, the adoption of these equations would be likely to significantly reduce test burden in comparison to the current version of the test



procedure that does not include these equations and requires the heat-up and cool-down test data in order to accurately calculate AFUE. Further, DOE believes the costs discussed above to recalculate efficiency using the new equations are small relative to the overall cost of manufacturing, testing, and certifying residential furnace and boiler products. For the reasons stated above, DOE certifies that this rule will not have a significant economic impact on a substantial number of small entities. Therefore, DOE did not prepare a final regulatory flexibility analysis for the final rule. DOE has transmitted its certification and a supporting statement of factual basis to the Chief Counsel for Advocacy of the SBA for review pursuant to 5 U.S.C. 605(b). Thus, DOE reaffirms and certifies that this rule will not have a significant economic impact on a substantial number of small entities.

### C. Review Under the Paperwork Reduction Act of 1995

Manufacturers of residential furnaces and boilers must certify to DOE that their products comply with any applicable energy conservation standards. In certifying compliance, manufacturers must test their products according to the DOE test procedures for residential furnaces and boilers, including any amendments adopted for those test procedures on the date that compliance is required. DOE has established regulations for the certification and recordkeeping requirements for all covered consumer products and commercial equipment, including residential furnaces and boilers. (76 FR 12422 (March 7, 2011)). The collection-of-information requirement for the certification and recordkeeping is subject to review and approval by OMB under the Paperwork Reduction Act (PRA). This requirement has been approved by OMB under OMB control number 1910-1400. Public reporting burden for the certification is estimated to average 20 hours per response, including the time for reviewing instructions,

searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the PRA, unless that collection of information displays a currently valid OMB Control Number.

#### D. Review Under the National Environmental Policy Act of 1969

In this final rule, DOE amends its test procedure for residential furnaces and boilers. DOE has determined that this rule falls into a class of actions that are categorically excluded from review under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*) and DOE's implementing regulations at 10 CFR part 1021. Specifically, this rule amends an existing rule without affecting the amount, quality, or distribution of energy usage, and, therefore, will not result in any environmental impacts. Thus, this rulemaking is covered by Categorical Exclusion A5 under 10 CFR part 1021, subpart D, which applies to any rulemaking that interprets or amends an existing rule without changing the environmental effect of that rule. Accordingly, neither an environmental assessment nor an environmental impact statement is required.

#### E. Review Under Executive Order 13132

Executive Order 13132, "Federalism," 64 FR 43255 (August 10, 1999) imposes certain requirements on agencies formulating and implementing policies or regulations that preempt

State law or that have Federalism implications. The Executive Order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive Order also requires agencies to have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have Federalism implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR 13735. DOE examined this final rule and has determined that it will not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of today's final rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297(d)) No further action is required by Executive Order 13132.

#### F. Review Under Executive Order 12988

Regarding the review of existing regulations and the promulgation of new regulations, section 3(a) of Executive Order 12988, "Civil Justice Reform," 61 FR 4729 (Feb. 7, 1996), imposes on Federal agencies the general duty to adhere to the following requirements: (1) eliminate drafting errors and ambiguity; (2) write regulations to minimize litigation; (3) provide a clear legal standard for affected conduct rather than a general standard; and (4) promote simplification and burden reduction. Regarding the review required by section 3(a), section 3(b) of Executive Order 12988 specifically requires that Executive agencies make every reasonable effort to ensure that the regulation: (1) clearly specifies the preemptive effect, if any; (2) clearly

specifies any effect on existing Federal law or regulation; (3) provides a clear legal standard for affected conduct while promoting simplification and burden reduction; (4) specifies the retroactive effect, if any; (5) adequately defines key terms; and (6) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. Section 3(c) of Executive Order 12988 requires Executive agencies to review regulations in light of applicable standards in sections 3(a) and 3(b) to determine whether they are met or it is unreasonable to meet one or more of them. DOE has completed the required review and determined that, to the extent permitted by law, this final rule meets the relevant standards of Executive Order 12988.

#### G. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA) requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. Pub. L. No. 104-4, sec. 201 (codified at 2 U.S.C. 1531). For a regulatory action resulting in a rule that may cause the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector of \$100 million or more in any one year (adjusted annually for inflation), section 202 of UMRA requires a Federal agency to publish a written statement that estimates the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a), (b)) The UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of State, local, and Tribal governments on a “significant intergovernmental mandate,” and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect them. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA.

62 FR 12820. (This policy is also available at <http://energy.gov/gc/office-general-counsel>.)

DOE examined today's final rule according to UMRA and its statement of policy and determined that the rule contains neither an intergovernmental mandate, nor a mandate that may result in the expenditure of \$100 million or more in any year. Accordingly, no further assessment or analysis is required under UMRA.

#### H. Review under the Treasury and General Government Appropriations Act, 1999

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. 105-277) requires Federal agencies to issue a Family Policymaking Assessment for any rule that may affect family well-being. Today's final rule will not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment.

#### I. Review Under Executive Order 12630

Pursuant to Executive Order 12630, "Governmental Actions and Interference with Constitutionally Protected Property Rights," 53 FR 8859 (March 18, 1988), DOE has determined that this regulation will not result in any takings that might require compensation under the Fifth Amendment to the U.S. Constitution.

#### J. Review Under Treasury and General Government Appropriations Act, 2001

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516 note) provides for agencies to review most disseminations of information to the public under information quality guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452 (Feb. 22, 2002),

and DOE's guidelines were published at 67 FR 62446 (Oct. 7, 2002). DOE has reviewed today's final rule under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

#### K. Review Under Executive Order 13211

Executive Order 13211, "Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use," 66 FR 28355 (May 22, 2001), requires Federal agencies to prepare and submit to OMB, a Statement of Energy Effects for any significant energy action. A "significant energy action" is defined as any action by an agency that promulgates or is expected to lead to promulgation of a final rule, and that: (1) is a significant regulatory action under Executive Order 12866, or any successor order; and (2) is likely to have a significant adverse effect on the supply, distribution, or use of energy; or (3) is designated by the Administrator of OIRA as a significant energy action. For any significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use if the regulation is implemented, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use.

Today's regulatory action to amend the test procedure for measuring the energy efficiency of residential furnaces and boilers is not a significant regulatory action under Executive Order 12866 or any successor order. Moreover, it would not have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as a significant energy action by the Administrator of OIRA. Therefore, it is not a significant energy action, and, accordingly, DOE has not prepared a Statement of Energy Effects for this rulemaking.

#### L. Review Under Section 32 of the Federal Energy Administration Act of 1974

Under section 301 of the Department of Energy Organization Act (Pub. L. 95–91; 42 U.S.C. 7101 *et seq.*), DOE must comply with all laws applicable to the former Federal Energy Administration, including section 32 of the Federal Energy Administration Act of 1974 (Pub. L. 93-275), as amended by the Federal Energy Administration Authorization Act of 1977 (Pub. L. 95-70). (15 U.S.C. 788; FEAA) Section 32 essentially provides in relevant part that, where a proposed rule authorizes or requires use of commercial standards, the notice of proposed rulemaking must inform the public of the use and background of such standards. In addition, section 32(c) requires DOE to consult with the Attorney General and the Chairman of the Federal Trade Commission (FTC) concerning the impact of the commercial or industry standards on competition.

The modifications to the test procedures addressed by this action do not incorporate by reference any testing methods that are not currently incorporated in the DOE test procedure for residential furnaces and boilers. DOE's final rule continues to use ASHRAE 103-1993 (Method of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers) as the basis for the DOE test procedure, while adding two necessary equations.

#### M. Congressional Notification

As required by 5 U.S.C. 801, DOE will report to Congress on the promulgation of today's rule before its effective date. The report will state that it has been determined that the rule is not a "major rule" as defined by 5 U.S.C. 804(2).

## **V. Approval of the Office of the Secretary**

The Secretary of Energy has approved publication of this final rule.

### **List of Subjects in 10 CFR Part 430**

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Imports, Incorporation by reference, Intergovernmental relations, Small businesses.

Issued in Washington, DC, on June 26, 2013.

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Kathleen B. Hogan  
Deputy Assistant Secretary for Energy Efficiency  
Energy Efficiency and Renewable Energy



For the reasons stated in the preamble, DOE amends part 430 of Chapter II, subchapter D of title 10, Code of Federal Regulations as set forth below:

**PART 430 – ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS**

1.The authority citation for part 430 continues to read as follows:

**Authority:** 42 U.S.C. 6291-6309; 28 U.S.C. 2461 note.

2. Appendix N to subpart B of part 430 is amended by:

- a. Revising sections 10.0 and 10.1;
- b. Redesignating sections 10.2, 10.2.1, 10.2.1.1, 10.2.1.2, 10.2.1.3, 10.2.1.4, 10.2.2, 10.2.3, 10.3, 10.5.1, 10.5.3, 10.6.1, 10.6.2, 10.6.3, 10.7.1, and 10.9 as sections 10.4, 10.4.1, 10.4.1.1, 10.4.1.2, 10.4.1.3, 10.4.1.4, 10.4.2, 10.4.3, 10.5, 10.7.1, 10.7.3, 10.8.1, 10.8.2, 10.8.3, 10.9.1, and 10.11; and
- d. Adding sections 10.2 and 10.3.

The revisions and additions read as follows:

**Appendix N to Subpart B of Part 430 – Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers**

\* \* \* \* \*

10.0 Calculation of derived results from test measurements. Calculations shall be as specified in section 11 of ANSI/ASHRAE 103-1993(incorporated by reference, see §430.3) and the October 24, 1996, Errata Sheet for ASHRAE 103-1993, except for sections 11.5.11.1, 11.5.11.2, and appendices B and C; and as specified in sections 10.1 through 10.10 and Figure 1 of this appendix.

10.1 Annual fuel utilization efficiency. The annual fuel utilization efficiency (AFUE) is as defined in sections 11.2.12 (non-condensing systems), 11.3.12 (condensing systems), 11.4.12 (non-condensing modulating systems), and 11.5.12 (condensing modulating systems) of ANSI/ASHRAE 103-1993 (incorporated by reference, see §430.3), except for the definition for the term  $\text{Effy}_{\text{HS}}$  in the defining equation for AFUE.  $\text{Effy}_{\text{HS}}$  is defined as:

$\text{Effy}_{\text{HS}}$  = heating seasonal efficiency as defined in sections 11.2.11 (non-condensing systems), 11.3.11 (condensing systems), 11.4.11 (non-condensing modulating systems), and 11.5.11 (condensing modulating systems) of ANSI/ASHRAE 103-1993, except that for condensing modulating systems sections 11.5.11.1 and 11.5.11.2 are replaced by sections 10.2 and 10.3 of this appendix.  $\text{Effy}_{\text{HS}}$  is based on the assumptions that all weatherized warm air furnaces or boilers are located outdoors, that warm air furnaces that are not weatherized are installed as isolated combustion systems, and that boilers that are not weatherized are installed indoors.

10.2 Part-Load Efficiency at Reduced Fuel Input Rate. Calculate the part-load efficiency at the reduced fuel input rate,  $Eff\gamma_{U,R}$ , for condensing furnaces and boilers equipped with either step modulating or two-stage controls, expressed as a percent and defined as:

$$Eff\gamma_{U,R} = 100 - L_{L,A} + L_G - L_C - C_f L_f - \left[ \frac{t_{ON}}{t_{ON} + \left( \frac{Q_P}{Q_{IN}} \right) t_{OFF}} \right] \eta (L_{S,ON} + L_{S,OFF} + L_{H,ON} + L_{H,OFF})$$

If the option in section 9.10 of ASHRAE 103-1993 (incorporated by reference, see §430.3) is employed:

$$Eff\gamma_{U,R} = 100 - L_{L,A} + L_G - L_C - C_f L_f - \left[ \frac{t_{ON}}{t_{ON} + \left( \frac{Q_P}{Q_{IN}} \right) t_{OFF}} \right] (C_D)(L_{S,FF})$$

Where:

$L_{L,A}$  = value as defined in section 11.2.7 of ASHRAE 103-1993

$L_G$  = value as defined in section 11.3.11.1 of ASHRAE 103-1993 at reduced input rate,

$L_C$  = value as defined in section 11.3.11.2 of ASHRAE 103-1993 at reduced input rate,

$L_f$  = value as defined in section 11.4.8.1.1 of ASHRAE 103-1993 at maximum input rate,

$t_{ON}$  = value as defined in section 11.4.9.11 of ASHRAE 103-1993,

$Q_P$  = pilot flame fuel input rate determined in accordance with section 9.2 of ASHRAE 103-1993 in Btu/h

$Q_{IN}$  = value as defined in section 11.4.8.1.1 of ASHRAE 103-1993,

$t_{OFF}$  = value as defined in section 11.4.9.12 of ASHRAE 103-1993 at reduced input rate,

$L_{S,ON}$  = value as defined in section 11.4.10.5 of ASHRAE 103-1993 at reduced input rate,

$L_{S,OFF}$  = value as defined in section 11.4.10.6 of ASHRAE 103-1993 at reduced input rate,

$L_{I,ON}$  = value as defined in section 11.4.10.7 of ASHRAE 103-1993 at reduced input rate,

$L_{I,OFF}$  = value as defined in section 11.4.10.8 of ASHRAE 103-1993 at reduced input rate,

$C_J$  = jacket loss factor and equal to:

- = 0.0 for furnaces or boilers intended to be installed indoors
- = 1.7 for furnaces intended to be installed as isolated combustion systems
- = 2.4 for boilers (other than finned-tube boilers) intended to be installed as isolated combustion systems
- = 3.3 for furnaces intended to be installed outdoors
- = 4.7 for boilers (other than finned-tube boilers) intended to be installed outdoors
- = 1.0 for finned-tube boilers intended to be installed outdoors
- = 0.5 for finned-tube boilers intended to be installed as isolated combustion systems

$L_{S,SS}$  = value as defined in section 11.5.6 of ASHRAE 103-1993 at reduced input rate,

$C_S$  = value as defined in section 11.5.10.1 of ASHRAE 103-1993 at reduced input rate.

10.3 Part-Load Efficiency at Maximum Fuel Input Rate. Calculate the part-load efficiency at maximum fuel input rate,  $Eff_{y_{U,H}}$ , for condensing furnaces and boilers equipped with two-stage controls, expressed as a percent and defined as:

$$Eff_{y_{U,H}} = 100 - L_{L,A} + L_G - L_C - C_J L_J - \left[ \frac{t_{ON}}{t_{ON} + \left( \frac{Q_P}{Q_{IN}} \right) t_{OFF}} \right] (L_{S,ON} + L_{S,OFF} + L_{H,ON} + L_{H,OFF})$$

If the option in section 9.10 of ASHRAE 103-1993 (incorporated by reference, see §430.3) is employed:

$$Eff_{y_{U,H}} = 100 - L_{L,A} + L_G - L_C - C_J L_J - \left[ \frac{t_{ON}}{t_{ON} + \left( \frac{Q_P}{Q_{IN}} \right) t_{OFF}} \right] (C_S)(L_{S,SS})$$

Where:

$L_{L,A}$  = value as defined in section 11.2.7 of ASHRAE 103-1993,

$L_G$  = value as defined in section 11.3.11.1 of ASHRAE 103-1993 at maximum input rate,

$L_C$  = value as defined in section 11.3.11.2 of ASHRAE 103-1993 at maximum input rate,

$L_J$  = value as defined in section 11.4.8.1.1 of ASHRAE 103-1993 at maximum input rate,

$t_{ON}$  = value as defined in section 11.4.9.11 of ASHRAE 103-1993,

$Q_P$  = pilot flame fuel input rate determined in accordance with section 9.2 of ASHRAE 103-1993 in Btu/h,

$Q_{IN}$  = value as defined in section 11.4.8.1.1 of ASHRAE 103-1993,

$t_{OFF}$  = value as defined in section 11.4.9.12 of ASHRAE 103-1993 at maximum input rate,

$L_{S,ON}$  = value as defined in section 11.4.10.5 of ASHRAE 103-1993 at maximum input rate,

$L_{S,OFF}$  = value as defined in section 11.4.10.6 of ASHRAE 103-1993 at maximum input rate,

$L_{I,ON}$  = value as defined in section 11.4.10.7 of ASHRAE 103-1993 at maximum input rate,

$L_{I,OFF}$  = value as defined in section 11.4.10.8 of ASHRAE 103-1993 at maximum input rate,

$C_J$  = value as defined in section 10.2 of this appendix,

$L_{S,SS}$  = value as defined in section 11.5.6 of ASHRAE 103-1993 at maximum input rate,

$C_S$  = value as defined in section 11.5.10.1 of ASHRAE 103-1993 at maximum input rate.

\* \* \* \* \*